

Computational methods in engineering design and optimization

Guest Editorial: Engineering Computations: International Journal for Computer-Aided Engineering and Software, Volume 30, Issue 4

Guest Editors: Massimiliano Vasile, Edmondo Minisci, Domenico Quagliarella

Across all fields of engineering sciences, many design problems are now tackled using computational techniques that aim at optimizing system performance. The evolution of complex systems has progressed along with the development of computational methods that can treat more and more complex design and simulation problems. All engineering areas, from power generation and distribution, to structural mechanics and materials, from optimal control to aerodynamics, have benefited from the development of increasingly sophisticated computational techniques. Today, the improvement in computer performance allows numerical simulation to replace a big portion of experimental tests, and numerical optimisation to handle complex, multidisciplinary design problems.

Many techniques have been developed in a number of fields, including automobile design, naval architecture, electronics, computers, and electricity distribution. A large number of applications are in the field of aerospace engineering, such as aircraft and spacecraft design in which disciplines such as aerodynamics, structural analysis, propulsion, control theory, and economics are integrated in a single optimization process.

This special issue collects many, diverse efforts made in the development of computational methods and techniques for design and optimization across all the fields of engineering and physical sciences. The issue brings together researchers from around the globe for a stimulating discussion on recent advances in computational methods for the solution of any engineering problem. The issue looks with particular interest for methods specifically devised, adapted or tailored to address problems in design optimization of complex engineering systems applications or computational methods that were demonstrated to be particularly effective at solving MDO related problems and difficult real-world applications.

This special issue collects extended and revised versions of some of the papers accepted at EUROGEN2011 ECCOMAS Thematic Conference, plus a number of original contributions. In accordance with the spirit of the conference, focused on topics of great interest to economic and industrial fields, it gives a unique overview on the state-of-the-art in computational methods applied to the design and optimization of engineering problems, covering arguments as diverse as single and multiobjective optimization for ship design, optimal aerodynamic shape design, uncertainty quantification, optimal topological design of structures, game theoretic approaches, design and control of electronic and energy systems. It should be noted that in many of the papers published in this special issue, the importance of the applicative subject treated is accompanied by the introduction of innovative and original analysis and solution methods, or the improvement of state of the art techniques such as for optimization problems in CFD, the adjoint method for fast gradient computation and the proper orthogonal decomposition for building high quality surrogate evaluation methods.

The special issue is made of three parts. This first part is collecting a number of development and applications of computational methods to problems in aeronautics and fluid dynamics design and optimisation.